LESSON PLAN

PART I
COVER SHEET

LESSON TITLE: Dosimeters and Chargers

TRAINING METHOD: Demonstration-Performance

REFERENCES: FEMA, SM 5.1, Handbook for Radiological Monitors (Oct 81)
T.O. 11H4-6-3-61, Radiological Dosimeter Charger, Model 750-5B, (1 Nov 74)
T.O. 11H4-6-1-1, Ion Chamber Dosimeters (1 Feb 68, Chg 21)
T.O. 11H4-2-12-1, RADIAC Detector Charger (30 Aug 68, Chg 12)

AIDS AND HANDOUTS: Charger and Dosimeter
FEMA, SM 5.1, Handbook for Radiological Monitors
Attachment 1. Illustration of the Dosimeter Scale

LESSON OBJECTIVE: Given an explanation and a demonstration of dosimeters and chargers, the student, during the final course exam, must properly perform all of the task steps listed below and one of the samples of behavior listed below:

TASK STEPS:

1. Identify and inspect parts of the dosimeters and chargers.

2. Demonstrate how to charge dosimeters.

3. Demonstrate how to read dosimeters.

4. Demonstrate preventive maintenance procedures for chargers and dosimeters.

SAMPLES OF BEHAVIOR:

1. State the purpose of the dosimeters and chargers.

2. State the dosimeter's unit of measurement and range.

3. State the parts of the dosimeters and chargers.

4. Describe dosimeter uses.

ORGANIZATIONAL PATTERN: Topical

SUGGESTED COURSE(S) OF INSTRUCTION: Disaster Preparedness Support Team
Shelter Management Team

STRATEGY: Explain the purpose of dosimeters and charges upon issuing them to the students. Using the T.O.s, have the students follow your demonstration and familiarization with their issued equipment. During student performance stress the samples of behavior (i.e. purpose, unit of measurement, parts, etc.) Brief the cautions and warnings listed in the T.O.s.

LESSON OUTLINE:

MAIN POINT 1. PURPOSE OF THE DOSIMETERS AND CHARGERS

MAIN POINT 2. GENERAL DESCRIPTION
- A. Dosimeters
- B. Chargers

MAIN POINT 3. THEORY AND PRINCIPLES OF OPERATION
- A. Dosimeters
- B. Chargers

MAIN POINT 4. DOSIMETER USES
- A. Use Outside the Shelter
- B. Use in a Shelter

MAIN POINT 5. HOW TO USE DOSIMETERS AND CHARGERS.

MAIN POINT 6. MAINTENANCE
- A. Dosimeters
- B. Chargers

PART II
TEACHING PLAN
INTRODUCTION

ATTENTION: You can survive radiological fallout hazards by being aware of the tools available to measure contamination.

MOTIVATION: After a nuclear attack radiological fallout hazards will be one of the major threats we have to deal with. Your knowledge of how to use dosimeters and chargers will help implement an effective exposure control program for personnel in order to continue with mission capability.

OVERVIEW: Today, we'll cover:

1. The purpose of dosimeters and chargers.
2. General descriptions.
3. Theory and principles of operation.
4. Dosimeter uses.
5. How to use a dosimeter and charger.
6. Maintenance for both.

TRANSITION: Now, let's begin with why the dosimeter is a useful tool for radiation detection and measurement.

BODY

MAIN POINT 1. PURPOSE OF DOSIMETERS AND CHARGERS

Dosimeters detect and measure cumulative exposure to X-ray and gamma-ray radiation. The dosimeter is our primary tool used to detect and measure exposure. The dosimeter can be clipped to the user's pocket or to some object in the area to measure for total radiation exposure.

The dosimeter charger is a portable charger unit designed for use with Air Force dosimeters. This instrument provides the necessary voltage to charge the dosimeter to zero and illuminate the dosimeter scale so that it may be read.

INSTRUCTOR'S NOTE: Show the students the dosimeters and charger that will be covered. Identify the major parts and the function of these parts using T.O.s 11H4-2-12-1 and 11H4-6-1-1.

MAIN POINT 2. GENERAL DESCRIPTION

There are some specific descriptions for both instruments. The dosimeter, as stated, is used to measure and detect radiation while the charger is used to illuminate and charge the dosimeter in order to give these accurate readings.

A. DOSIMETER DESCRIPTION

A. The dosimeter is a hermetically sealed assembly in a metal barrel. A magnifying eyepiece is contained inside the barrel for reading units of measure for gamma radiation on a scale calibrated in roentgens(R) or milliroentgens(mR).

The dimensions are approximately 4 1/2 inches long and 1/2 inch in diameter, with a weight of 1 1/2 ounces.

INSTRUCTOR'S NOTE: For technical characteristics, see T.O. 11H4-6-1-1, Section 1, fig. 1-1 and 1-3.

It has a metal pocket clip on the viewing end of the metal barrel and a removable, plastic protective dust cap over the charging end of the dosimeter to prevent foreign matter from entering the dosimeter.

There are five different types of dosimeters available for use:

1. One Civil Defense (CD); CDV-742 measuring 0 to 200R.

2. Four military;
   a. IM-9 /PD-measuring 0 to 200mR
   b. IM-93A/PD- measuring 0 to 600R
   c. IM-135 /PD-measuring 0 to 5R
   d. IM-143 /PD-measuring 0 to 600R

B. CHARGERS

B. A dosimeter charger is a battery operated portable unit. It is a metal box 4-1/8" square by 2-7/8" high and approximately 1-1/4 lb. with the battery installed.

The CDV-750 charger is powered by one 1-1/2 volt "D" size flashlight battery. Battery replacement is necessary whenever the scale illuminator is dim or the hairline cannot be brought to zero.

All the electrical components with the exception of the charging contact assembly are mounted on a printed circuit board. The T.O. provides instructions on the repair, servicing, modification, and maintenance of the charger.

INSTRUCTOR'S NOTE: Refer to all cautions and warnings for proper handling of this equipment as stated, T.O. 11H4-2-12-1, section 2.

It features a charging contact that illuminates a light when slightly depressed and engages the charging circuit when fully depressed. The position of the hairline inside a dosimeter is adjusted by rotating the voltage control knob marked "UPSCALE-DOWNSCALE".

MAIN POINT 3. THEORY OF OPERATION

For information purposes, the principles of operation of the dosimeter are separated into three areas, construction details, electrometer assembly functions, and optical system functions. We will discuss the basic function of the dosimeter.

When the dosimeter is placed in a radioactive field, X-rays and gamma rays ionize the air in the ionization chamber. (Alpha rays and most beta rays do not have sufficient penetrating power to pass through the metal barrel of the dosimeter.)

The transfer of negative ions to the quartz fiber and positive ions to the ionization chamber wall causes a partial neutralization of the original charge.

The quartz fiber moves toward the support wire a distance proportional to the total amount of radiation (dose) to which the dosimeter has been exposed.

The light passing through illuminates the calibrated scale. The resultant image, a shadow of the quartz fiber hairline superimposed on the calibrated scale is magnified by the eyepiece for viewing by the user.

A. DOSIMETER

A. The dosimeter will operate with or without the protective cap. However to read, remove the cap and hold that end up to a light source.

(1.) READING DOSIMETER

(1.) To read a dosimeter, place it on the charging contact and press down lightly to switch on the light. Do not press harder than necessary or the reading will be lost.

To read the calibrated scale:

⇒ Look at a light source through the eyepiece lens of the dosimeter.

⇒ Rotate the dosimeter until the calibrated scale is in the horizontal position.

⇒ Note the position of the hairline on the calibrated scale.

Determine the amount of radiation detected.

(2.) ACCUMULATED READINGS

(2.) Since the calibrated scale of the dosimeter is linear, the total amount of radiation exposure for a selected period of time can be determined by subtracting the reading taken at the beginning of the time period from the reading taken at the end of the time period.

(3.) CHARGING A DOSIMETER

(3.) A dosimeter is charged with a charger. Remove the protective cap from the charging end of the dosimeter. Press it down on the charging contact with sufficient force to bring the dosimeter body in contact with the threaded portion of the charging assembly.

CAUTION: Do not press any harder than necessary to activate the lamp or the reading will be lost.

Read the dosimeter and adjust the voltage control by turning the control knob until the dosimeter hairline indicates zero. Remove the dosimeter from the charging contact and check the reading by holding it up to a light.

Rezero if necessary. Replace the protective cap over the charging end of the dosimeter.

B. CHARGER

B. The charger is battery operated and provides illumination for the dosimeter while being read or charged. The circuit is powered by a 1.5 volt battery.

A potential of 220 volts maximum is available at the charging pin. The dosimeter to be charged must be pressed down so that it loses the circuit between the charging pin and ground.

Preparation of the charger for operation is quite simple. Remove the case, install the "D" cell battery in the opening provided. The battery will fit only one way into the holder. Do not attempt to force it into position. Replace the case and tighten.

INSTRUCTOR'S NOTE: Use the diagrams in T.O. 11H4-6-3-61, Fig. 1, to assists in explaining the theory of operation.

When the "D" cell is nearly discharged and a new one is not available, the charger can still be made to operate. There are two steps that can be taken:

⇒ Open the case, adjust the core in T1 in a clockwise direction. This increases the charging voltage to compensate for the lost battery voltage.

⇒ If the above doesn't work, remove the lamp I1. The lamp requires much more current than the charging circuit. The battery may have enough energy to operate the charging circuit, but not the lamp. Without the lamp it will be necessary to make adjustments in small steps while reading the dosimeter each time with another source of illumination.

MAIN POINT 4. DOSIMTER USES

Dosimeters provide a method for determining radiation doses of personnel, either individually or collectively for groups of people and inside shelters.

A. DOSIMETER USE OUTSIDE THE SHELTER

A. When individuals or work teams depart the shelter they are issued a dosimeter to record their cumulative exposure while away from the shelter. It is clipped to the individual's (or to one of the team member's) interior clothing in order to prevent particulate contamination.

B. DOSIMETER USE IN A SHELTER

B. Within shelters, the representative radiation dose of the occupants is determined by placing dosimeters in selected areas throughout the shelter. All personnel within these areas are assumed to have the exposure indicated by the dosimeter within their area.

Using this information, exposure can be equalized for all shelter occupants by rotating them through the areas periodically.

MAIN POINT 5. PREVENTIVE MAINTENANCE FOR DOSIMETERS

Maintenance for the dosimeter consists of preventive maintenance, checking leakage rate, and calibration.

A. PREVENTIVE MAINTENANCE	A. Consists of cleaning, decontaminating, and maintaining a charge.
(1) CLEAN	(1) To clean: (a.) Remove the protective cap from the dosimeter. Carefully wash the open ends of the dosimeter with denatured alcohol. (b.) Thoroughly dry the dosimeter by rapidly waving it in the air. Reinstall the protective dust cap on the dosimeter. Lost or defective caps can be replaced. **CAUTION: The charging end of the dosimeter must be free of lint and moisture. Do not blow on the dosimeter and do not use a drying cloth.**
(2) DECONTAMINATE	(2) To decontaminate: (a.) Prepare a solution of detergent and clean water. Wash the dosimeter thoroughly. Rinse in clean water. (b.) Wash both ends of the dosimeter with denatured alcohol and wave in the air to dry.

(3) MAINTAINING THE CHARGE

(3) To maintain the charge of dosimeters:

-- STANDBY STATUS

(a.) When storing dosimeter in standby status:

⇒ Charge the dosimeter to zero reading.

⇒ Place in area free from dust and radiation.

⇒ Recharge every 28 days for the length of time the dosimeter is in standby status.

⇒ When removed from standby for operational use, check the leakage rate.

INSTRUCTORS NOTE: Use the procedures in T.O. 11H4-6-1-1 to check the leakage rate of the dosimeter.

-- OPERATIONAL STATUS

(b.) When the dosimeter is removed from standby status for operational use, check the leakage rate and then recharge as follows:

⇒ Charge the dosimeter to zero reading.

⇒ Place in area free from dust and radiation.

⇒ Charge the dosimeter every 14 days and adjust to zero. This will maintain the constant charge required to prevent excessive leakage.

B. CHECKING LEAKAGE RATE

B. The charge that is placed on the dosimeter will leak off gradually, even in a radiation-free area.

NOTE: If the dosimeter has not been charged every 14 days and is then fully charged, excessive leakage may occur. Do not perform a leakage-rate check on the dosimeter until it has been charged to zero reading for five consecutive days.

INSTRUCTOR'S NOTE: The leakage rate is referenced in T.O. 11H4-6-1-1, Fig. 1-2, Section I.

C. CALIBRATION AND CORRECTION FACTORS

C. Ion chamber dosimeters used will be calibrated at intervals not to exceed 90 days. Dosimeters will be calibrated at 12 month intervals. This calibration is provided for the user by the Precision and Measure Equipment Laboratory (PMEL). Any discrepancies in readings will be identified and corrected at this time by PMEL.

NOTE: **Correction factors are introduced and attached to dosimeters that may read higher or lower than the intiensity of the radiation field**.

B. CHARGERS

B. Preventive maintenance will be performed every 28 days when the instrument is in use and once every 180 days when it is in storage.

(1.) PREVENTIVE MAINTENANCE

(1.) The preventive maintenance required:

⇒ Remove the battery when the dosimeter charger is to be stored and clean the battery contacts if they appear corroded. If operation is intermittent, clean the battery contacts.

⇒ Check the battery and the two bulbs. Replace the spare bulb if it has been removed from its holder.

(2.) OPERATOR MAINTENANCE

(2.) Operator maintenance should be limited to replacing the battery, cleaning the contacts, and inspecting for visible faults. If the lamp appears dim or does not light, replace the battery.

(3.) CHECK MODIFICATIONS

(3.) Be sure the modification has been accomplished for USAF usage. To determine if this modification has been made:

⇒ Open the case by loosening the knurled case fastener with fingers and visually inspect for the existence of a disc or tubular type C3 capacitor.

⇒ The CDV 750 modification for USAF use will include this C3 capacitor, to prevent erratic readings, on the dosimeters and a USAF sticker over the Civil Defense emblem.

NOTE: To install capacitor C3, if missing or unserviceable, refer to T.O. 11H4-6-3-61, Section II, para 2-6.

(4.) CHECK ELECTRIC OPERATION BY CHARGING DOSIMETER

(4.) Check the electric operation by charging a dosimeter. The dosimeter hairline should be clearly visible and it should rest on zero when the voltage control is somewhere near the center of its rotation.

(5.) STORING CHARGER	(5.) When you store the instrument, remove the battery from the battery compartment.
(6.) FOR BATTERY LEAKAGE	(6.) If a battery has leaked, remove the case bottom and clean as directed in T.O. 11H4-2-12-1, Section 2.

CONCLUSION

SUMMARY: We have covered dosimeters and chargers and the main topics were:

1. The purpose of dosimeters and chargers.

2. Instrument descriptions.

3. Theories of operation.

4. Dosimeter uses.

5. How to use dosimeters and chargers.

6. Maintenance for dosimeters and chargers.

REMOTIVATION: Your knowledge of how to maintain and use dosimeters and chargers will help implement an effective exposure control program for measuring contamination for your base personnel.

CLOSURE: This concludes this lesson.

TRANSITION: (Develop locally to transition to the next topic.)

PART III
EVALUATION
STUDENT PERFORMANCE STANDARDS

1. Identify and inspect parts of the dosimeters and chargers.
2. Demonstrate how to charge dosimeters.
3. Demonstrate how to read dosimeters.
4. Demonstrate preventive maintenance procedures for the chargers.
5. Demonstrate preventive maintenance prcedures for the dosimeters.

TEST ITEMS

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1. LESSON OBJECTIVE: State the purpose of the dosimeters and chargers.

QUESTION: (True or False)

Dosimeters measure accumulated or cumulative exposure to X-ray and gamma radiation.

a. True
b. False

KEY: a.

REFERENCE: Main Point 1.

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2. LESSON OBJECTIVE: State the dosimeter's unit of measurement and range.

QUESTION: (Multiple Choice)

The IM-93A/PD dosimeter has a range from zero to ___?

a. 200 milliroentgens.
b. 5 roentgens.
c. 200 rentgens.
d. 600 roentgens.

KEY: d.

REFERENCE: Main Point 2A.

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3. LESSON OBJECTIVE: State the parts of the dosimeters and chargers.

QUESTION: (Multiple Choice)

Which of the following are parts of the dosimeter?

a. Headset jack, batteries, and scale switch.
b. Charging post, carryinghandle, and check source.
c. Clip assembly, metal barrel, and magnifying eyepiece.
d. Metal barrel, probe shield, and probe cable.

KEY: c.

REFERENCE: Main Point 2A.

4. LESSON OBJECTIVE: Describe dosimeter uses.

QUESTION: (True or False)

When dosimeters are used inside a shelter they are normally placed in selected areas. Personnel within these areas are assumed to have the exposure indicated by the dosimeter.

a. True
b. False

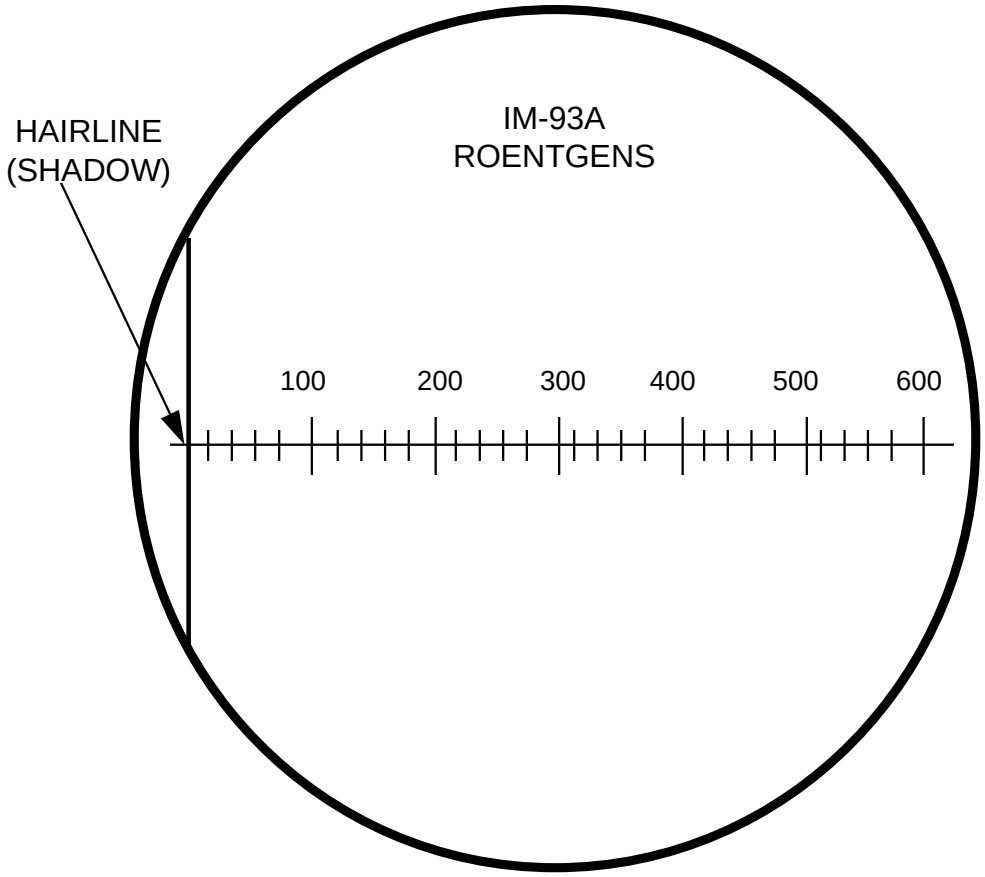
KEY: a

REFERENCE: Main Point 5.

PART IV
RELATED MATERIALS

ATTACHMENT 1. Illustration of Dosimeter Scale.
RTP D1 Shelter Operations
RTP D3 Exposure Control Operations in a Fallout Environment
RTP F14 ADM-300A Multi-Function Survey Meter

CALIBRATED SCALE OF A DOSIMETER



Attachment 1 - Dosimeter Scale

TRAINING PACKAGE COMMENT REPORT

RTP #	RTP DATE

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